

SWITCHED SERVICES NETWORKS
USING CENTRAL OFFICE SWITCHING MACHINES
DESCRIPTION

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1. GENERAL

1.01 This section describes the general features of Switched Services Networks (SSN) using Central Office Switching Machines. These networks are used to switch private lines involving large numbers of trunks and subscriber loops in accordance with the requirements of the customer. These networks may provide for transmission of voice, data or secure voice. Additional descriptive information on optional features of specific systems may be found in other sections of this series of practices.

1.02 In order to provide standard terminology and reduce confusion, a glossary of terms and their definitions as applied in SSN are provided in Appendix A. Whenever these terms appear in this practice, associated practices of this Plant Series or other associated practices, the assumed definition will be as specified in Appendix A.

1.03 The switched services network is a system which may provide station-to-station dialing. It will automatically select a direct route or may select an alternate route for a call, if trunk routing permits.

1.04 The customer may provide each station on the network a directory which assists the user in placing network calls. To originate a call, a subscriber dials the distant location or places the call through a PBX operator.

1.05 The SSN may use a segregated switching system or it can share certain common control equipment and other items. These include power, building space, distributing frames, etc, which can be shared with the 2-wire office used for the message network, if equipped with wire spring relays.

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1.06 Circuit order and routine test requirements for network trunks, 4-wire subscriber lines, and access lines are covered in Section 310-200-300. Testing methods are covered in Section 310-200-500 and associated sections. Requirements and testing methods for PBX facilities are covered in other sections.

2. SERVICE FEATURES

2.01 All standard basic service features available in central office switching machines may be provided. These are discussed in the appropriate practices for each type of central office. Some service features which are used on switched services networks are discussed below.

(A) Class of Service

2.02 The class of service mark is a feature of the switching machines used in these networks. It is used to segregate the customers or networks sharing common switching machines. It may also be used to indicate the call privileges specified by the subscriber. Table I shows an example of the class of service marks used on a network of this type.

TABLE I

CLASS OF SERVICE	USE	
AA	PBX	Subscriber Line with ES* (4W Class Mark)
BB	PBX	Subscriber Line without ES (2W Class Mark)
CC	Data	Regular Single User (4W Class Mark)
DD	Data	Candidate for Camp-on, Single User (4W Class Mark)
EE	Secure Voice	Candidate for Camp-on, Single User (4W Class Mark)
FF	Dual Use	Voice and Data with ES on Subscriber Line (4W Class Mark)
HH	Dual Use	Voice and Secure Voice with ES on Subscriber Line and Future Camp-on Candidate (4W Class Mark)

CLASS OF SERVICE	USE	
II	5D	ES not required in Intercity Trunk (4W Class Mark)
JJ	5D	ES is required in Intercity Trunk (2W Class Mark)
KK	Selected User (VIP)	(4W Class Mark)

* Echo Suppressor

(B) Line Load Control

2.03 This feature is provided to control the originating traffic. In the case of abnormally high traffic loads due to an emergency, serious traffic loads or other conditions could cause common control equipment to be overloaded. The line load control may be preset so that selected users will be able to complete calls. Line load control may be divided into three classes such as A-20% of the lines, B-40% of the lines, and C-40% of the lines. Class A will never be denied originating service by the operation of line load control equipment. Incoming service will not be denied to any customer.

(C) Four-Wire Station-to-Station Switching

2.04 Four-wire operation can be provided on a connection from station to station when the stations home on 4-wire offices. This permits the system to accommodate stringent data requirements and special communications.

(D) Provision of Special Features

2.05 Special features may be provided on an automatic basis under Class of Service control. They may also be provided on a selective basis under the user's control.

2.06 The special features described in the following paragraphs are controlled by the operation of auxiliary pushbuttons, by the keying of a prefix code at Touch-Tone sets, or by dialing a prefix code at dial sets. The auxiliary buttons on the Touch-Tone set are marked P (priority) and SG (special grade trunking).

2.07 The record of the P and SG signals received by an originating register is forwarded to the marker in digital form at the completion of dialing. The proper call privilege is determined by the marker by referring to the class of service for the originating line.

(E) Priority

2.08 Priority features in 4-wire offices are available for 4-wire lines which permit a call, so marked, to indicate that it should be given priority handling. This feature will be used primarily in military networks. The priority treatment may be in the form of Camp-on, where the call will wait on a busy trunk group and seize the first idle trunk ahead of other calls. Dial "0" calls can be routed by the attendant to a special trunk group which has the priority feature when all the regular trunks may be busy. If 5D Switchboards are provided, the call may also be transferred to an assistance operator at the terminating office 5D Switchboard if the called line is busy or fails to answer in a prescribed time interval. Pre-emption may also be provided. This permits the caller to seize a circuit in use for some other call.

2.09 Priority may be restricted to selected lines. Also, it may be fully automatic or may require dialing a prefix to the called number to start its operation.

(F) Special Grade Trunking

2.10 A special grade trunking feature is available for 4-wire lines which permits a call, so marked, to be routed over specially conditioned trunks. Special grade trunks are required for Secure Voice and some forms of data, telephoto or facsimile traffic.

2.11 By using 4-wire circuits entirely for Secure Voice messages, the following advantages are provided:

- (a) Full duplex operation without push-to-talk operation.
- (b) Simultaneous transmission of Secure Voice in both directions.
- (c) Improved signal transmission.

Secure Voice is provided primarily in military networks.

2.12 Although data can be transmitted over 2-wire circuits, difficult requirements may necessitate full 4-wire transmission. Full duplex operation and unique check and control arrangements are possible. With proper equalization, the same 4-wire facilities provided for voiceband can be used for facsimile and telephoto transmission as well.

(G) Downgrade

2.13 Downgrade provides a means of canceling all privileges furnished on an automatic basis by using a dialed prefix.

3. OVER-ALL NETWORK CONCEPT

3.01 The basic switching plans are shown in Figs. 1 and 2. These are typical designs required for a switched services network. The hierarchy switching plan shown in Fig. 1 is similar to the DDD network. However, there may be some basic differences due to the customer's service requirements. For example, the calling rate and the calling pattern for a specific customer may be such that direct (high usage) trunks are limited in number for economy reasons. This may mean that on the average more trunks will be connected in tandem for a given connection than would be experienced if direct trunks were provided such as are available in the DDD network. The maximum number should be limited by proper design.

3.02 To the degree that 4-wire switching and 4-wire transmission are used throughout the plan, the following advantages are realized:

- (a) Improved echo performance.
- (b) Improved singing margin.
- (c) Improved conferencing arrangements.
- (d) Trunks operated at a lower loss.
- (e) Loops operated at a higher loss.
- (f) Better sidetone control.

(A) Hierarchy Plan

3.03 The basic features of the hierarchy switching plan shown in Fig. 1 are outlined below and discussed in more detail in subsequent paragraphs.

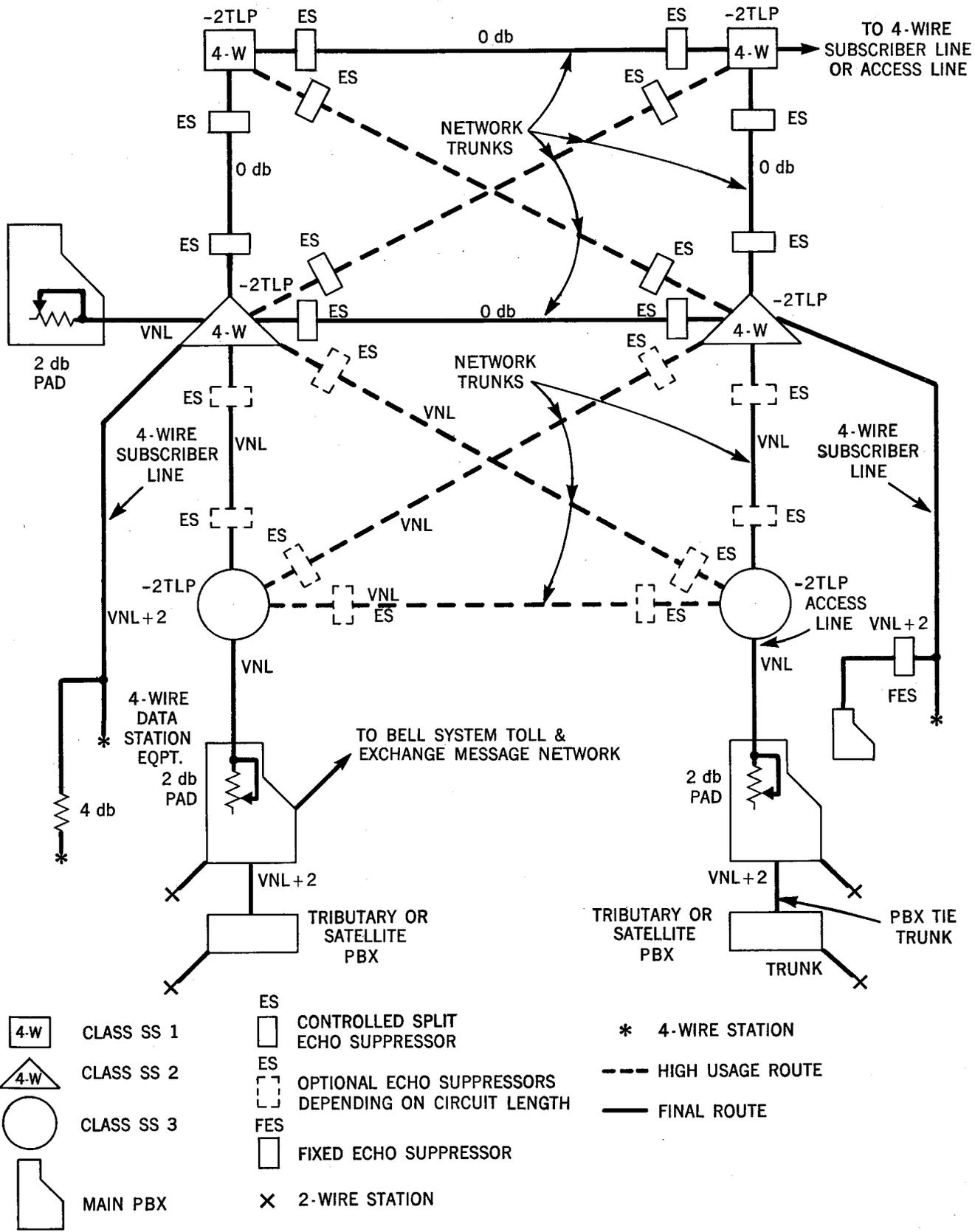


Fig. 1 - Typical Hierarchy Switching Plan

- All switching at Class SS -1 or SS -2 offices is 4-wire. SS -3 offices may be 2-wire although from a transmission standpoint, 4-wire is preferred.
 - Alternate routing is provided within the routing capabilities of the machine to meet the customer's requirements, providing his requirements warrant this feature.
 - Network trunks and access lines normally use 4-wire facilities.
 - Network trunks may be conditioned by gain-frequency and envelope delay equalization, when necessary, to handle the customer's transmission requirements.
 - Trunk groups between 4-wire offices may be split into more than one grade, if economically desirable. The selection of trunk grade can be made at the 4-wire station.
 - Interconnection of the switched services network with the DDD network (Universal Service) may be provided within certain limitations as discussed in related point sections.
 - 2- or 4-wire station equipment can be used on 4-wire subscriber lines served by 4-wire offices.
- 3.04** The basic design for the hierarchy plan is similar to that used for the DDD network. However, some improvements such as better facility selection can be made. The basic plan does not include envelope delay equalization. Normally, gain-frequency equalization should only be applied to the extent necessary to meet the DDD standards.
- 3.05** When the customer's requirements are more stringent than can be met by the basic plan, equalization may be provided on the network trunks, access lines and/or subscriber lines on a special basis in accordance with tariff considerations and if authorized by the PLSO.
- 3.06** The switched services network has the capability of providing many types of telephone and data services. For instance, any service that is normally provided at a 2-wire PBX on the DDD network can be provided on a switched services network. Voice grade services over a switched services network may nor-

mally be improved, however, since the maximum trunks in tandem can be limited by the switching design of the system to a smaller number than in the DDD network.

3.07 Class SS-1 offices are avoided unless the customer's requirements for circuit assurance or the need for circuit economies indicate a need for them. The reason is that the addition of Class SS-1 offices tends to increase the number of trunks in a connection for a hierarchy plan and this may make the satisfactory transmission of some types of data impractical.

3.08 When data is transmitted over the DDD network, the error rate performance is variable and may not be as good as it would normally be for a switched services network. However, the hierarchy plan without equalization, as described in these practices, should provide a grade of service better than that provided by the DDD network. If performance better than this is required, the network trunks, access lines, and subscriber lines can be specially conditioned to meet the customer's requirements on a special basis in accordance with tariff considerations and if authorized by the PLSO.

3.09 Secure Voice can be handled over the DDD network on a limited basis only. For instance, access to the message network for 2-wire Secure Voice must be made through a Class 5 office in close proximity to a Class 1 or Class 2 office. However, when this service is provided over a switched services network the type of facilities can be selected and specially conditioned to provide a more reliable service. Also, 4-wire Secure Voice can be transmitted from station-to-station using 4-wire subscriber lines and network trunks between 4-wire switching machines. This cannot be done over the DDD message network.

3.10 Universal service calls may in some cases originate or terminate in the DDD network and connect with a station of the switched services network. Universal service poses some definite transmission limitations, and satisfactory transmission will normally occur only when interconnection with the DDD network is limited to one point on each call. That is, a call which traverses the switched services network should not originate and also terminate in the DDD network.

TABLE II

COMPARISON OF HIERARCHY AND DDD SWITCHING MACHINES AND PBX's

NOTES	HIERARCHY	DDD
(1)	Classes SS-1 & SS-2	Classes 1 & 2
	Class SS-3	Class 3
(2)	Main PBX	Class 4
	Tributary or Satellite PBX off Main PBX	Class 5
	Satellite PBX off Tributary or PBX	Part of a Subscriber Loop
	Station Loops at a Main, Tributary or Satellite PBX	
4-wire Subscriber Lines		

Notes:

- (1) Class SS-1 offices should be avoided, if possible, for reasons cited previously.
- (2) If no tributary or satellite PBX "homes" on a main PBX, the main PBX may, depending upon universal service requirements, be treated as a Class 5 office.

TABLE III

COMPARISON OF HIERARCHY AND DDD CIRCUIT NOMENCLATURE

NOTES	HIERARCHY	TYPE OF FACILITY	DDD
	Network Trunks	4-wire	Intertoll Trunks
(1)	Access Lines	4-wire	Intertoll Trunks
	PBX Tie Trunks (Main PBX to Tributary or Satellite PBX)	2- or 4-wire	Toll Connecting Trunk
	PBX Station Loop Off a Main PBX or off a Tributary or Satellite "Homing" on Main PBX	2- or 4-wire	Subscriber Loop
	Tie Trunk from a Tributary PBX to a Satellite plus the Station Loop from the Satellite	2-wire	Subscriber Loop
	4-wire Subscriber Lines		

Notes:

- (1) If no tributary or satellite PBX exists, it may be possible to make the access lines 2-wire.

3.11 Table II shows the similarity between the hierarchy and the DDD switching machines and PBX's. Table III shows a comparison of the circuit nomenclature between the two networks.

(B) Hub Plan

3.12 Fig. 2 shows a sketch of a typical hub switching plan. This type of switching applies primarily to military networks. The hub concept arranges the switching centers in a particular zone or area into three rings which "home" on each other. These are called Inner, Middle and Outer rings. Normally, the switching offices which comprise the Inner ring are completely interconnected by trunk groups which are ideally served by physically separated trunk groups to improve survivability. In addition, each group should, if possible, be split into at least two subgroups, each traversing separated routes. For economic reasons, the switching centers comprising the Inner ring are usually limited to only a few offices.

3.13 The Middle ring switching offices are interconnected through the Inner ring offices. Ideally, the Middle ring offices have direct trunk groups to three Inner ring offices through diversified routes for circuit assurance reasons. A typical Middle ring arrangement will usually include more offices than in the Inner ring.

3.14 The Outer ring offices may be customer PBX's or Telephone Company offices. These have access to the Middle or Inner ring offices by means of a single group of access lines. The PBX's or offices will generally be 2-wire but can be 4-wire. The traffic originating at Outer ring offices is normally voice or other traffic where the transmission requirements are not critical. If high-speed data or other critical services are to be transmitted at an Outer ring office, the office should "home" on an Inner ring office. The number of Outer ring offices could be very large depending on the customer's requirements. These offices may also be interconnected by high usage trunks.

3.15 Fig. 2 shows that the Inner ring offices can be interconnected to other Inner ring offices in foreign zones. A foreign zone could be a similar ring in a foreign country or any other remote area. In order to minimize the number

of trunks in tandem on an interzone call, the Inner ring offices are interconnected as shown. Secure Voice or other critical services should be connected directly to an Inner ring office.

3.16 From a transmission standpoint, the features, capabilities and limitations of the hierarchy switching plan also pertain to the hub switching plan. That is, the Inner and Middle ring offices should be 4-wire equipment, the network trunks should be designed for 0 db loss, the same echo suppressor rules apply, etc.

3.17 The main advantage of the hub switching plan over the hierarchy plan is the survivability of at least one network trunk route in the event of an emergency. If a particular trunk group or office is lost for one reason or another, the remaining offices have the ability to route a call through other offices for completion.

(C) Office Impedances

3.18 The nominal impedances of the various switching points are shown in Table IV.

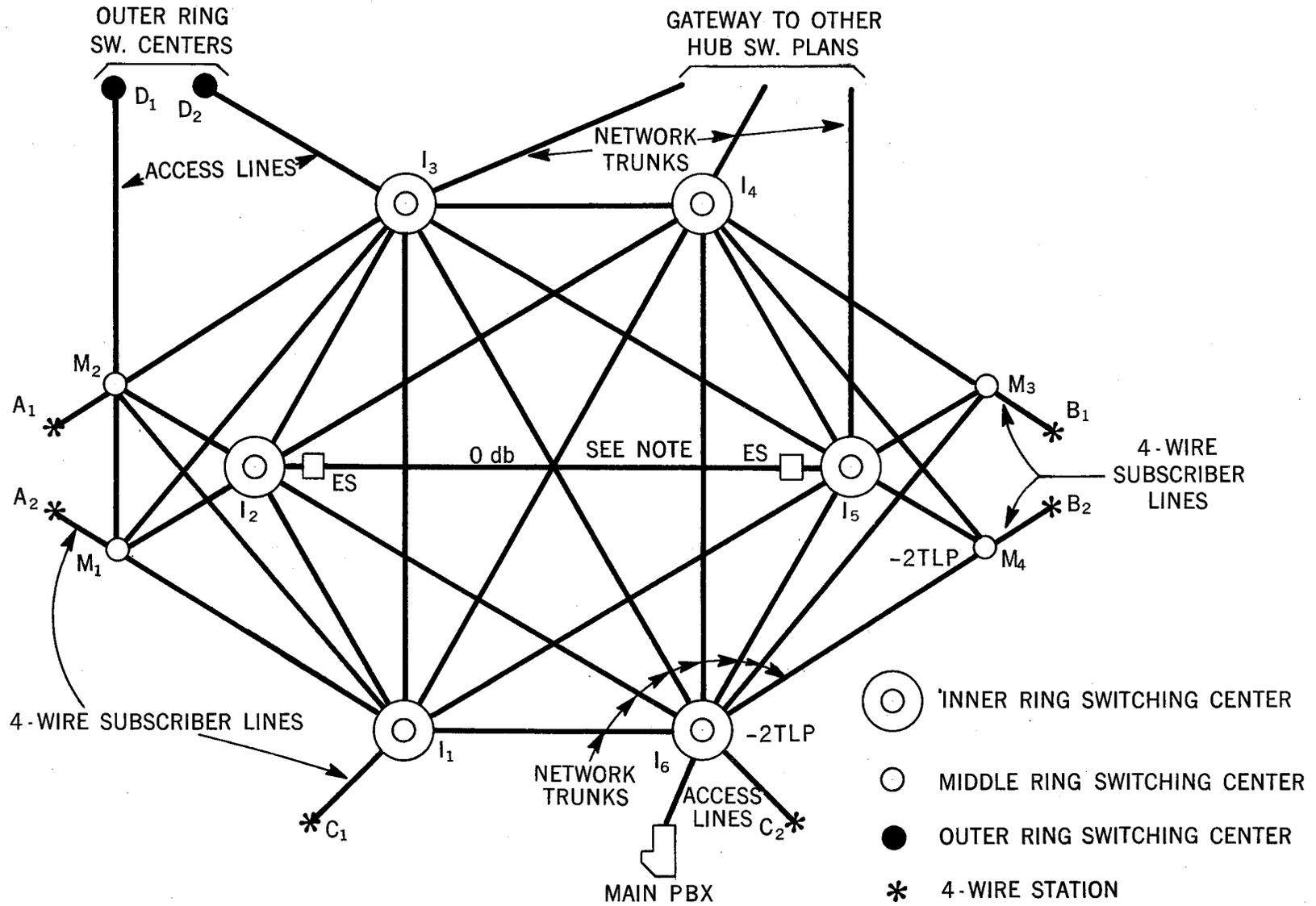
TABLE IV

CLASS OFFICE	IMPEDANCE
SS-1	600 ohms
SS-2	600 ohms
SS-3 (4-wire)	600 ohms
SS-3 (2-wire)	900 ohms
Main PBX	900 ohms
Tributary PBX	900 ohms
Satellite PBX	900 ohms

4. SWITCHING MACHINES

4.01 Several kinds of central office switching machines may eventually be used in switched services networks. At the present time, No. 5 crossbar is being used predominantly, because of its flexibility in meeting the customers' requirements.

4.02 A No. 5 crossbar office may be arranged for 4-wire switching only, or it may be arranged to handle 2-wire traffic as well. In a combined office the 2-wire train may provide CENTREX service for the subscriber's station



NOTE: ALL NETWORK TRUNKS ARE EQUIPPED WITH SPLIT ECHO SUPPRESSORS AND DESIGNED FOR 0 db LOSS.

Fig. 2 - Typical Hub Switching Plan

lines with direct inward and outward station dialing. In another type of combined office, the 2-wire train may be used as a conventional central office for switching commercial traffic. Joint usage of the 2-wire train for both PBX and Central office switching may be provided. Interconnection between the 2-wire and 4-wire trains may be provided.

(A) Two-Wire No. 5 Crossbar Offices

4.03 Standard 2-wire No. 5 crossbar offices may be used as SS-3 offices in the hierarchy plan. They may also serve as main PBX's when equipped for CENTREX service. Detailed descriptive information may be found in Section 958-110-100.

(B) Four-Wire No. 5 Crossbar Office

4.04 The 4-wire No. 5 crossbar office may be used as a class SS-1, SS-2, or SS-3 office in the hierarchy plan or as an Inner, Middle or Outer ring office in the hub plan. It has the same general operational features as two-wire No. 5 crossbar. It provides for common control, transmission testing with a master test frame, use of automatic transmission test lines, etc. All the standard signaling arrangements can be provided.

4.05 Several features have been provided in the 4-wire No. 5 crossbar design for use in the SSN. These include the proper line link and trunk link frames, 4-wire originating and incoming registers, etc, to provide for 4-wire switching and combined 2- and 4-wire switching. The features necessary for priority and special grade trunking are also available. A combined line and trunk circuit (LUNK) has also been developed to terminate access lines from SXS PBX's. Additional information on 4-wire offices used in switched services networks may be found in Section 958-150-100.

5. PBX COMPLEXES

(A) General

5.01 Some switched services networks consist of PBX complexes interconnected by 2-wire or 4-wire switching machines. The PBX complex will normally have access to an office

through a main (or serving) PBX. The main PBX will provide the network access for tributary and satellite PBX's.

5.02 Tributaries are those PBX's with attendant positions other than the main PBX. Satellite PBX's serve secondary locations of either the main or tributary PBX's. Satellites of tributary PBX's are not recommended for transmission reasons. Where this type of operation must be used, the satellite PBX will have direct tie trunks to the main PBX for outgoing calls. A block diagram of a PBX complex is shown in Fig. 3.

5.03 Incoming traffic for the PBX complex is, in general, distributed through facilities located at the main PBX to each PBX location. Completion to the listed number of the main and all tributary PBX's is provided. Those tributaries with insufficient traffic requirements to warrant listed number completion can be reached, when required, through the main PBX attendant. Network Inward Dialing (NID) to the stations at the serving, tributary or satellite PBX is provided where feasible. It can be provided where the facilities are arranged for Direct Inward Dialing (DID) from the message network. Incoming calls to the main PBX attendant from the network can also be extended into the message network within the area served by the PBX complex.

5.04 Originating network traffic from main PBX, tributary PBX and satellite PBX stations may be handled by Network Outward Dialing (NOD) or may be connected to the network by the operator at the main PBX switchboard. When calls are placed through the main PBX attendant, the facilities may be arranged to permit station dialing through the attendant's cords. Completion of calls from the message network (within the area served by the PBX complex) to a distant network termination may also be possible. In this case, however, attendant dialing will be required.

5.05 Supplementary facilities such as FX lines and direct tie lines to other PBX complexes are available at many network locations. They may also be arranged for NID or NOD, or they may be arranged for operator completion via the main PBX attendant.

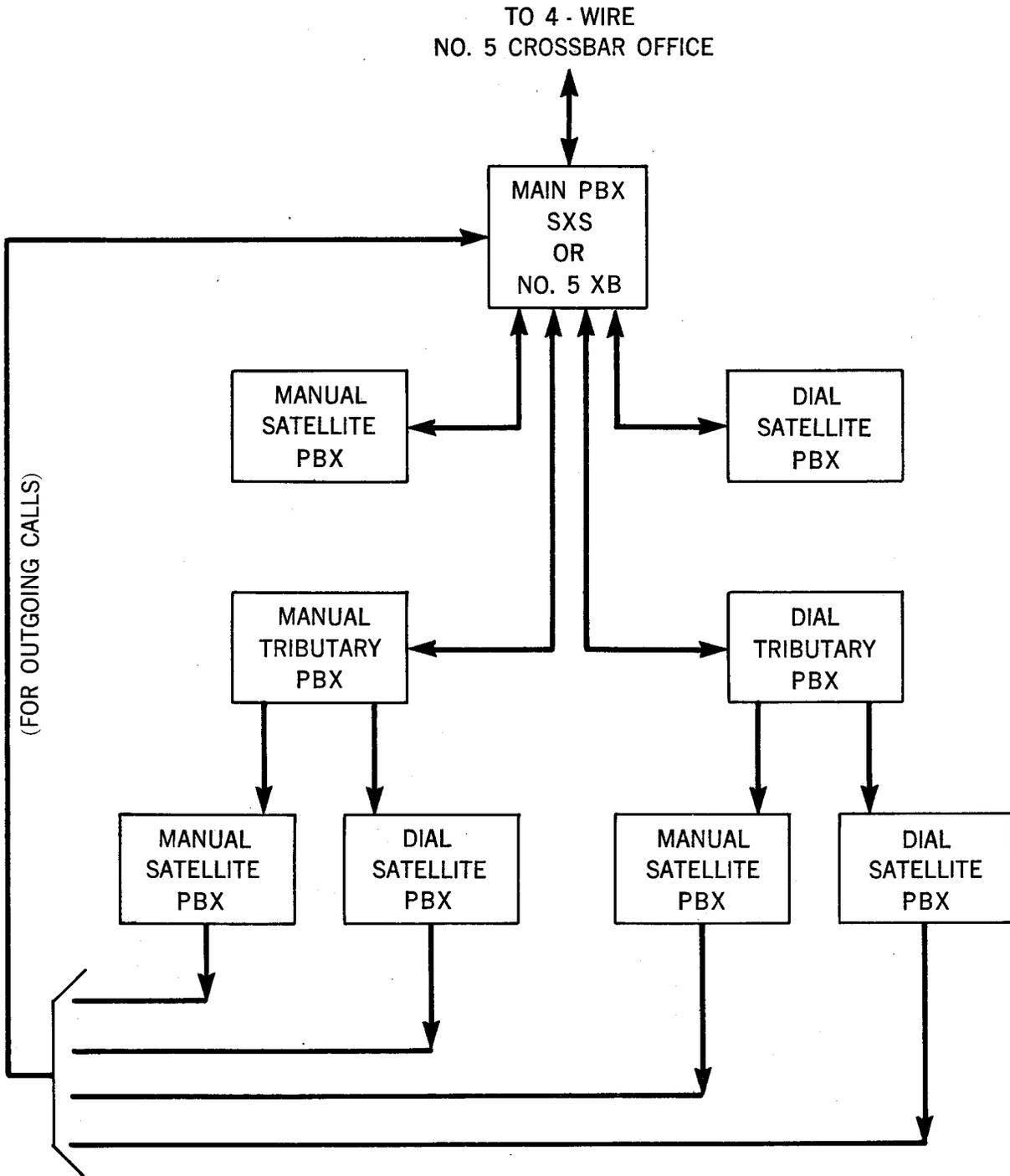


Fig. 3 - Block Diagram of PBX Complex with SXS Facilities at Main PBX

5.06 The main PBX may be equipped with attendant positions for listed number service, DSA origination of network traffic, etc. Some typical traffic arrangements are shown in Fig. 4.

(B) SXS Facilities at Main PBX

5.07 SXS dial equipment will be used frequently as the main PBX. The access lines to the 4-wire portion of the SSN will usually be terminated through a 2-way dial repeating tie trunk circuit to an incoming selector. The incoming selector may be arranged to terminate main PBX attendant trunks, main PBX incoming selectors and tributary tie trunks on different levels to permit NID service to the maximum extent. Arrangements for outgoing traffic will depend on whether traffic is handled through the main PBX attendant or on a NOD basis.

5.08 The tributaries and satellites of a SXS main PBX may be manual PBX's, SXS dial PBX's or No. 5 CENTREX offices. The type of equipment will determine the tie trunk circuits to be used and the extent that NID and NOD can be applied.

(C) No. 5 Facilities at Main PBX

5.09 A No. 5 crossbar office may be used as a CENTREX main PBX or as a tandem office. A typical arrangement is shown in Fig. 5.

6. SWITCHBOARDS

(A) 5C Switchboard

6.01 The 5C Switchboard provides a 4-wire manual switching system for locations where it is not desirable to provide a 4-wire No. 5 crossbar switching system. This switchboard provides connections to local or distant dial offices, 2-wire manual switchboards, 4-wire No. 5 crossbar offices and other 5C Switchboards.

(B) 5D Switchboard

6.02 The 5D Switchboard may be used as the 4-wire dial service assistance switchboard for the 4-wire No. 5 crossbar system. Talking connections are established by means of twin

plugs inserted in twin jacks, thereby obtaining 4-wire transmission through the board. The switchboard provides operating arrangements for the following items of traffic:

- (a) Dial "0" assistance for both priority and regular lines.
- (b) Verification.
- (c) Handling of incoming priority calls to busy lines or to lines that do not answer within a predetermined time.
- (d) Monitoring on busy lines and trunks.
- (e) Conference calls.
- (f) Trouble reports.
- (g) Information calls.
- (h) Intercept calls.
- (i) Permanent signal traffic.
- (j) Request for transfer on incoming calls.
- (k) Calls for operators' listed numbers (equivalent to 121 traffic).

6.03 Some of the arrangements, operating features and capacities of the 5D Switchboard are as follows:

- (a) All lamps in the switchboard are mounted in combined lamp socket and designation strip holders.
- (b) Two dial "0" assistance trunk groups are provided, one for priority traffic and the other for regular traffic. The priority group is selected when a data or encryption station user operates the "P" button and then dials "0".
- (c) On the network trunks, one busy and three answering lamps are provided. The busy lamp is for monitoring purposes and the answering lamps are for the following purposes:
 - (1) A lamp is provided to indicate that operator attention is required on an incoming priority call. Examples are: Priority call encountering a busy or DA exceeding the predetermined time interval, incoming priority call requiring line transfer or an incoming priority call to the operator's listed number.

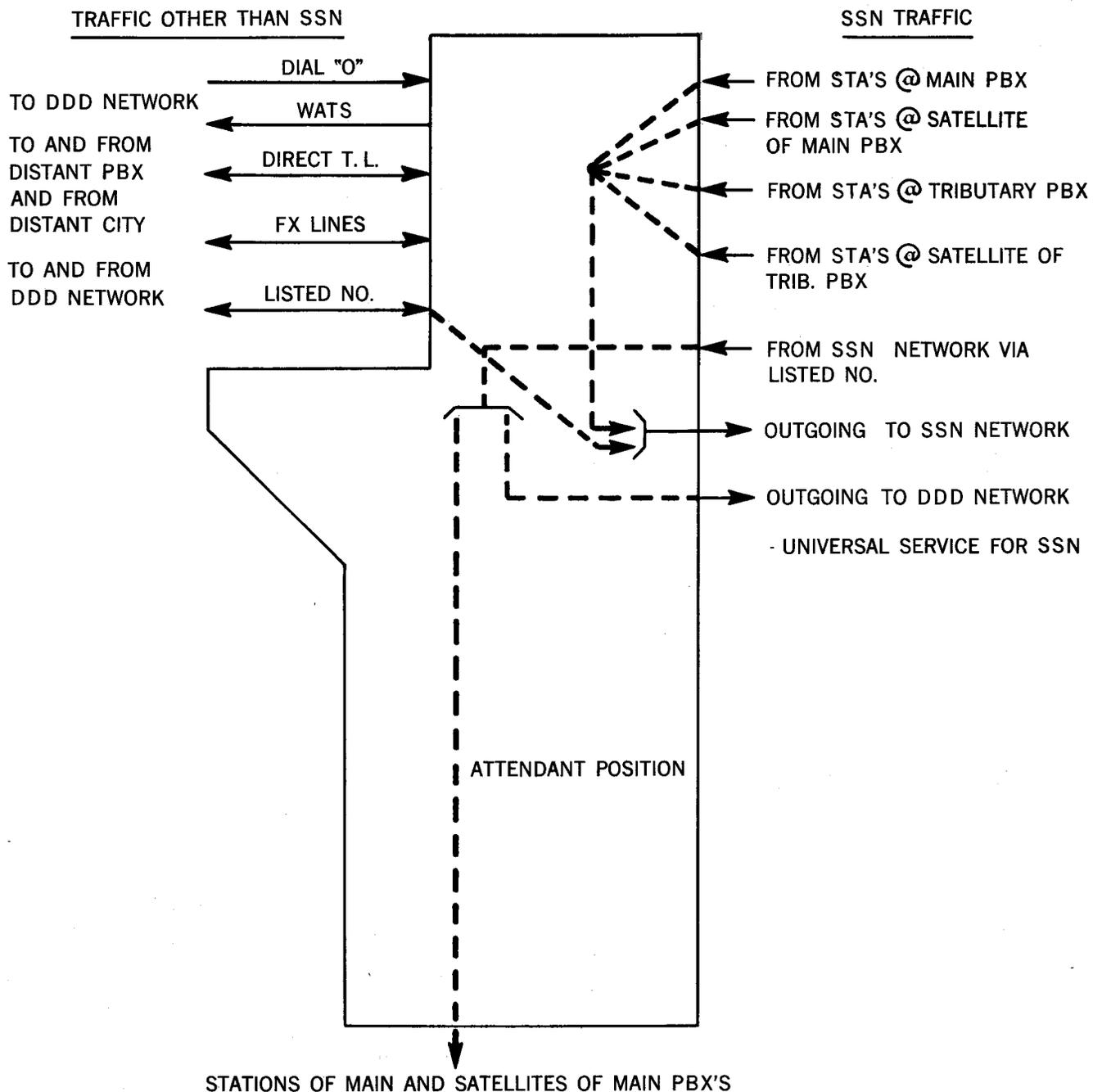


Fig. 4 - Switchboard at Main PBX-Connections for SSN Traffic

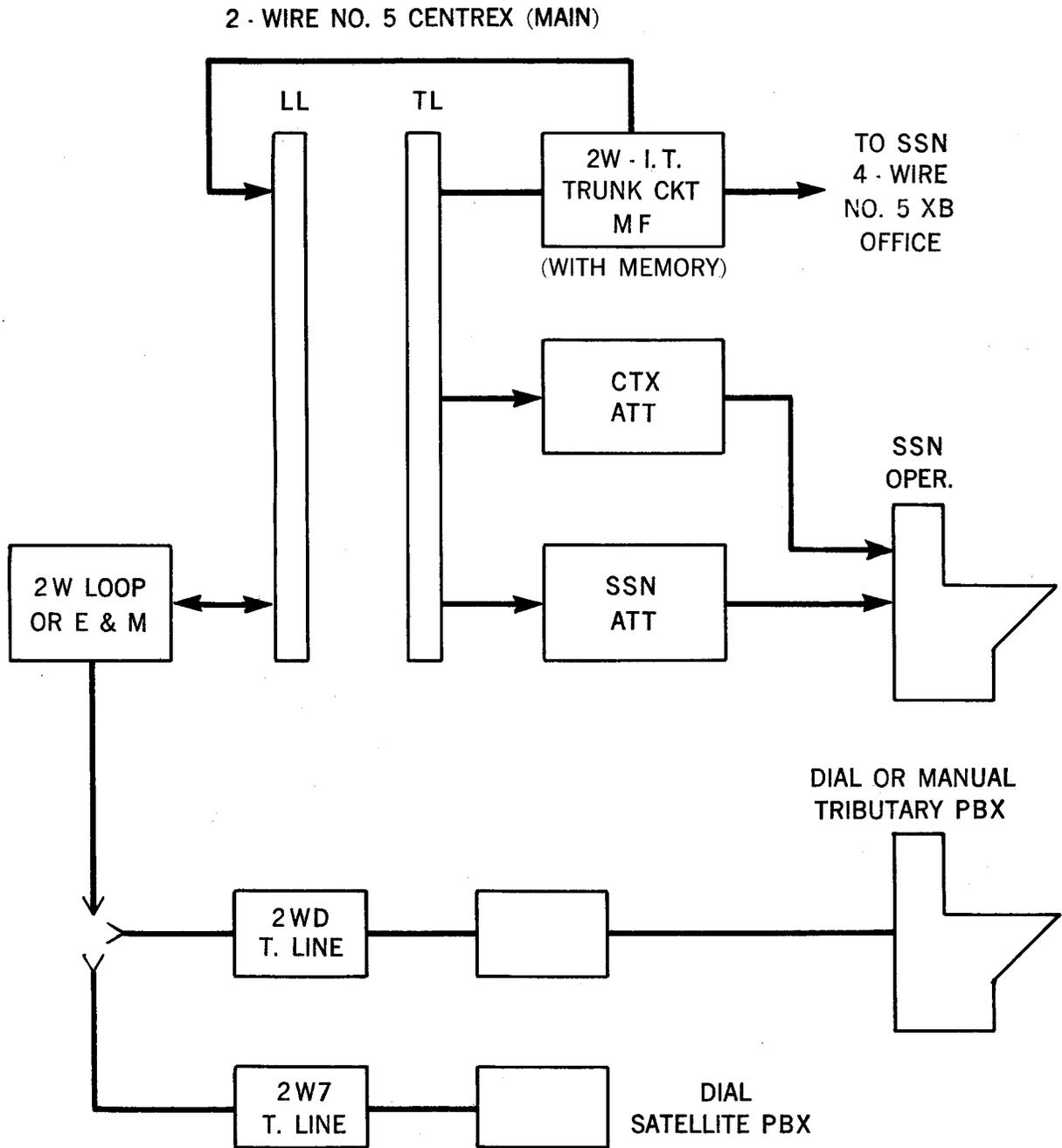


Fig. 5 - Block Diagram of Typical Arrangement of 2-Wire No. 5 CENTREX Office as Main PBX

(2) A lamp is provided to indicate that operator attention is required on a regular incoming call on which line transfer is required.

(3) A flashing lamp is provided to indicate that operator attention is required on an incoming regular call to the operator's listed number.

(d) Visual monitoring on a busy line or busy hunting group is accomplished when the plug of a line busy monitoring cord is inserted in an idle line indicating jack. The associated cord lamp signal will be dark while the line or hunting group is busy and will flash when a line becomes idle.

(e) The 5D Switchboard has appearances of vacant code trunks and permanent signal trunks. These are in addition to multipurpose tone and announcement trunks associated with the 4-wire, No. 5 crossbar equipment which:

- (1) Give 60 IPM tone to signify line busy.
- (2) Give 120 IPM tone to signify all trunks busy.
- (3) Give a recorded announcement from a single channel announcement machine on vacant code and partial dial calls.
- (4) Store permanent signal calls which exceed the capacity of the regular P.S. trunks.

(f) Monitoring on a "camp-on" call originated by the 5D operator is accomplished by observation of lamp signals on the cord. A steady lamp signal indicates that the call is "camping." When an outgoing trunk is seized to advance the call, the lamp flashes. In addition to the lamp signals, "camp-on" tone (a double zip tone) can be heard every three seconds.

7. STATION EQUIPMENT

7.01 Standard 2-wire telephone sets and key equipment are used to terminate 2-wire lines from No. 5 crossbar offices and PBX's. They may be equipped for either rotary dialing or Touch-Tone when the serving office or PBX is arranged for it.

(A) Touch-Tone Sets

7.02 The Touch-Tone telephone set uses pulsing tones in two bands. The low band is from 697 to 941 cycles and the high band is from 1209 to 1477 cycles. All frequencies are within ± 10 cycles. Table V shows the frequencies for each pushbutton on the set.

TABLE V

FREQUENCY	PUSHBUTTON SET		
	1209 CYCLES	1336 CYCLES	1477 CYCLES
697 cycles	1	2	3
770 cycles	4	5	6
852 cycles	7	8	9
941 cycles	P	0	SG

When a button is operated on the telephone set, two tones are transmitted. For instance, if the "2" button is pushed, the tones transmitted are 697 and 1336 cycles. If the "SG" button is pushed the tones are 941 and 1477 cycles.

(B) Four-Wire Station Sets

7.03 Four-wire station sets are available for use in SSN. For most uses, they will be equipped for Touch-Tone operation. In some cases, rotary dials may be provided for technical reasons, or for compatibility with other dial systems reached by the same set.

7.04 Both 4-wire lines and 2-wire local lines may terminate on the set. The station set provides a true 4-wire termination where required. Five lines in any combination of 4- and 2-wire lines may be terminated on the set. If the set is equipped with a secure voice transfer button, only four lines may be terminated. Where a larger number of lines must be terminated, a "call director" or other type of key telephone system will be used.

(C) Dual Use Lines

7.05 Dual use lines are provided when subscribers wish to use a facility as either a 4-wire subscriber line or as an access line. The transfer from one use to the other is done through an auxiliary line circuit on the subscriber's premises and controlled by the subscriber. A typical arrangement is shown in Fig. 6. Alternate use of the line for various types of station equipment using an additional auxiliary line circuit are also shown in Fig. 6.

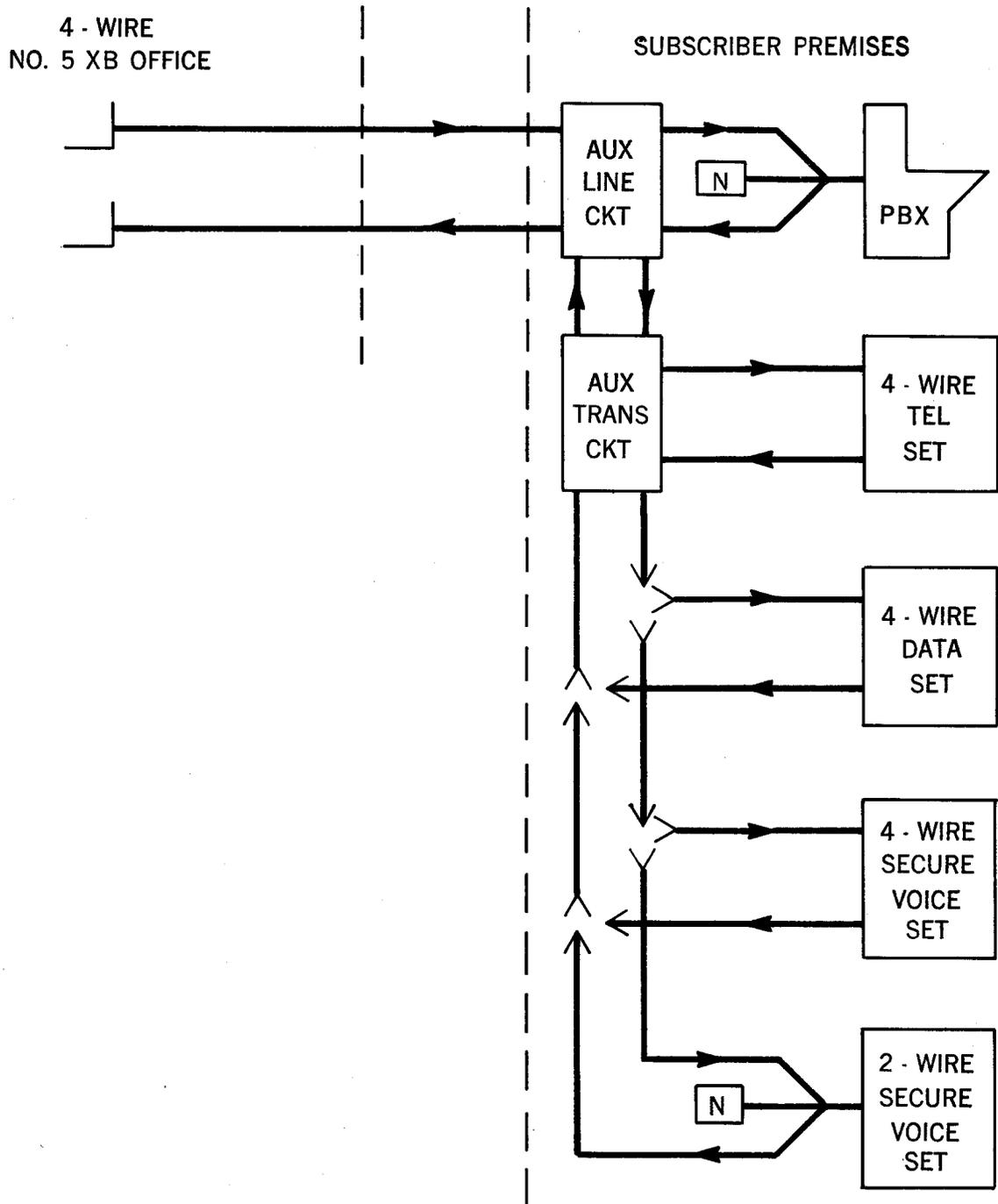


Fig. 6 - Typical Arrangements of Station Equipment for Dual Use Lines

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7.06 Dual use lines are always furnished on a 4-wire basis. They always home on a 4-wire office.

(D) Customer-Owned Station Equipment

7.07 The station equipment in some plans consists of government-operated PBX's and government-owned and operated data and secure voice equipment.

7.08 Data equipment may be also provided by other customers and is usually connected to the line through Bell System data subsets.

8. MAINTENANCE FEATURES

(A) Testboards

8.01 The *No. 19A testboard* will be used in 4-wire No. 5 crossbar offices. The 19A testboard consists of a test position and adjacent patch bay. All sectionalizing and over-all testing of network trunks, 4-wire subscriber lines and access lines is done at the 19A testboard. Also, one test bay per office is associated with the testboard to include the necessary testing apparatus for use in the maintenance of a switched services network. A description of the 19A testboard is found in Section 310-280-100.

8.02 Some of the tests which can be performed on station lines and trunks are:

- (a) Busy tests.
- (b) Talking and monitoring.
- (c) Originating outgoing or incoming calls to test lines in the same or distant offices or to station lines.
- (d) D.C. voltmeter and milliammeter tests on metallic station lines.
- (e) Signaling tests.
- (f) Transmission and noise tests.

8.03 Arrangements are available to switch trunks and 4-wire subscriber lines from the No. 5 crossbar equipment to the No. 5D Switchboard if provided for emergency manual operation. Interoffice and intraoffice trunks for plant communication are also available.

8.04 The *No. 17E testboard* will be used in class SS-3 2-wire No. 5 crossbar offices. Its description may be found in Section 310-281-100.

8.05 The *5A* test unit provides the facilities for sectionalizing and over-all testing of 4-wire subscriber lines and network trunks terminating at 5C Switchboard locations.

(B) Other Testing Facilities

8.06 A master test frame is located in the office maintenance center of both the 2-wire and 4-wire No. 5 crossbar offices. Three principal groups of tests are made:

- (a) Routine tests made periodically to detect conditions that may cause trouble due to maladjustment.
- (b) Trouble location tests that reproduce the conditions under which trouble recorder cards or alarms are obtained.
- (c) Verification tests of subscriber line cross-connections.

Sectionalization and location of transmission troubles are normally referred to the testboard. In 2-wire offices not equipped with the testboards, additional facilities may be provided at the MTF for this work.

8.07 The following 4-wire test trunks may be provided in 4-wire offices:

- (a) A code 100-type trunk from the TLF used as a quiet termination for far end noise measurements.
- (b) A code 101-type trunk from the TLF to the 19A testboard for transmission tests on incoming circuits on a two-man basis.
- (c) A code 102-type trunk for transmission and trouble location tests on incoming circuits.
- (d) A code 103-type trunk from the TLF for supervisory tests on incoming circuits.
- (e) A code 104-type trunk for two-way transmission tests on incoming circuits on a one-man basis.

8.08 100 series and/or equivalent series dial test lines may be provided in 2-wire No. 5 crossbar offices.

8.09 PBX's may also be equipped with a test line combination such as the combined milliwatt, balance and loop-around circuit. These may be used for one-man testing of facilities incoming at PBX's.

8.10 Order wire circuits, two-way automatic trunks to other office locations, two-way dial trunks to the local switching systems and other normally provided plant communication trunks are used in 2-wire and 4-wire offices.

8.11 Portable transmission testing equipment is available and should be provided as required.

8.12 In addition to the regular equipment, data, secure voice or dual use lines may have facilities provided to loop back the subscriber line for test purposes. This feature is for Plant's use and will consist of a lamp and key at the customer location.

GLOSSARY OF TERMS

1. Switched Services Network (SSN) — A plan for switching large numbers of private lines and trunks in accordance with the requirements of the customer.
2. Hierarchy Switching Network — An arrangement similar to the DDD network. It is arranged with classes of offices and has subscriber lines, access lines and network trunks.
3. Hub Switching Network — An arrangement whereby 4-wire switching offices "home" on each other for survivability reasons. There are no classes of offices similar to those in the DDD network, and multiple trunk routes are provided from each 4-wire office.
4. Switched Services Network-Offices (Classes SS-1, SS-2 and SS-3) — Switching offices used in the hierarchy plan and normally located on telephone company premises. The central office equipment used for the service will sometimes be an adjunct to existing equipment. Class SS-1 and SS-2 offices should always be 4-wire switching machines. Class SS-3 offices may be either 2-wire or 4-wire machines but should be 4-wire, whenever possible, for transmission reasons.
5. Network Trunk — A circuit between Class SS-3 or higher switching offices in the hierarchy plan or between any two offices in the hub plan. These circuits are designed for 0 db circuit net loss or VNL depending on the type of switching offices involved (2-wire or 4-wire) and whether echo suppressors are required.
6. Voice Grade Network Trunk — A trunk designed to the DDD network standards.
7. Special Grade Network Trunk — A trunk specially treated to give it transmission characteristics different than those found in the DDD network for the purpose of handling special services.
8. 4-Wire Subscriber Lines — Those circuits which connect 4-wire station apparatus such as telephone and data sets directly to 4-wire switching machines only. The circuits may also be used for dual use services. These circuits are provided where 4-wire operation from station-to-station is required or where the customer's transmission requirements are such that they can be met only by a specially designed circuit which bypasses the regular PBX access line and local PBX circuits.

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- 9. Dual Use 4-Wire Subscriber Lines — Lines designed for use either as subscriber lines or access lines. The circuits generally terminate in a 2-wire PBX for connection to 2-wire stations. The PBX and terminating set are bypassed when the circuit is used for 4-wire voice or data. A fixed nonsplit echo suppressor will always be required when the PBX uses the line.
- 10. Access Lines — Those circuits which connect main PBX's to Class SS-1, SS-2 or SS-3 offices in a hierarchy plan or to any office in a hub plan. These lines are normally 4-wire facilities and terminate on a 2-wire PBX or No. 5 CENTREX or tandem office. They are designed to operate on a VNL basis.
- 11. Key Station — A 2-wire station served by a station line directly off an SS-3 office.
- 12. LUNK — A combined line and trunk circuit which may be used on a 4-wire access line at a 4-wire No. 5XB office so that dialing toward a SXS main PBX may be accomplished.
- 13. Line Link Pulsing Circuit (LLP) — A circuit terminated on the line link frame of a 2-wire No. 5XB office which permits dialing toward a SXS PBX.
- 14. Controlled Echo Suppressor (CES) — Refers to the operation of the suppressor in the network trunk. Split echo suppressors are always provided on trunks between 4-wire machines. They are equipped for both tone disabling and mark enabling. During the idle condition the suppressors are not in the circuit. When the trunk is seized and the suppressor is required, a signal from the 4-wire machine activates the suppressor.
- 15. Fixed Echo Suppressor (FES) — One that is enabled permanently. It may be either a split or a nonsplit suppressor.
- 16. Tone Disabling — An equipment arrangement used to disable split echo suppressors for the transmission of data. The suppressor is removed from the circuit "electrically" by means of tone transmitted from the called data set.
- 17. PBX Complex — An arrangement of PBX's in an area consisting of a main PBX, tributary PBX's and satellite PBX's. The main PBX will normally be the switching point for access lines connecting the complex to a Class SS-3 or higher office in a hierarchy plan or to a 4-wire office in a hub plan.
- 18. Main PBX — Any PBX which has direct circuits to an SS-3 or higher class office.

19. Tributary PBX — A PBX which homes on a main PBX but has its own listed number.
20. Satellite PBX — A PBX which homes on a main or tributary PBX and has the listed numbers of the PBX on which it homes.
21. PBX Tie Trunk — A direct circuit between two PBX's.
22. Direct-In-Dialing (DID) — Direct dialing of the called PBX station over the message network.
23. Network-In-Dialing (NID) — Direct dialing of the called PBX station over the SSN.
24. Direct-Out-Dialing (DOD) — Direct dialing by the calling PBX station over the message network.
25. Network-Out-Dialing (NOD) — Direct dialing by the calling PBX station over the SSN.
26. Universal Service — Refers to the interconnection of a switched services network with the DDD network.
27. Priority — A method by which a call receives preferential treatment when it encounters a busy condition or no answer. Normally furnished on military networks and in 4-wire offices only.
28. Camp-on — A form of priority in which the waiting call is connected to the first idle trunk in a busy trunk group. Used in military networks only.
29. Pre-Emption — A form of priority which permits a call to seize facilities already in use for another call. Used in military networks only.
30. Secure Voice — A service provided to subscribers who wish to encode and decode voice messages at their station sets to prevent interception of the messages by a third party. Used in military networks only.
31. Line Load Control — A feature provided to permit control of access to a switching machine during heavy traffic periods.
32. Class of Service — A designation for the privileges a subscriber may be assigned. Also provides for segregation of customers served by common switching equipment.
33. Trunk Load Control — A feature which permits the customer to cut off PBX access to the network in an emergency.
34. Terminating Priority — A feature which advances a call to an assistance operator if it encounters an all trunk busy or called line busy conditions.

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- 35. Emergency Transfer Circuit — A circuit which permits automatic lines and trunks in a 4-wire No. 5 Crossbar office to be re-terminated as manual lines and trunks on a 5D Switchboard if provided. Usually used in military networks.
- 36. Intercept — The definition and use in SSN is the same as in the DDD network.
- 37. Route Advance (Alternate Routing) — An arrangement that permits routing from one trunk group to subsequent trunk groups when all trunks of the preceding group are busy.